

Prefabrication vs. Field Fabrication: Choosing the Right Strategy for Sanitary Process Projects

A TECHNICAL BRIEF AND PRACTICAL GUIDE

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Executive Summary

The choice between shop prefabrication and field fabrication is not a simple contest between two construction methods. It is a project-delivery decision that determines where work occurs, when risk is retired, and how much activity must be compressed into the plant shutdown window.

Prefabrication moves suitable work into a controlled shop environment. Field fabrication keeps the work close to actual equipment, tie-ins, and site conditions. Each approach solves a different set of problems. Most sanitary process projects perform best with a deliberate hybrid strategy: prefabricate repeatable, well-defined assemblies; reserve field fabrication for final connections, uncertain interfaces, and late-breaking changes.

The core principle is straightforward: maximize the work completed before the shutdown, but do not prefabricate beyond the accuracy of the available site information.

Why Fabrication Strategy Matters

Sanitary piping projects combine ordinary construction constraints with heightened requirements for cleanability, material control, weld quality, documentation, and startup readiness. Food current good manufacturing practices address plant and equipment design, sanitary operations, and process controls. Industry standards and accepted practices also address hygienic equipment and piping design, fabrication, installation, inspection, and testing.

The fabrication location affects more than labor hours. It influences weld access, purge control, contamination exposure, inspection efficiency, drainability verification, traceability, packaging, rigging, safety exposure, and the number of unresolved tasks remaining when production stops.

- Greenfield projects may provide generous access and favor larger skids or modules.
- Brownfield projects may make off-site work more valuable because of production traffic, sanitation zoning, overhead congestion, and brief outages.
- Poorly documented facilities require measurement and verification before extensive prefabrication can be used safely.

Understanding the Two Strategies

Shop Prefabrication

Shop prefabrication means building pipe spools, valve clusters, equipment frames, utility manifolds, skids, or larger modules away from their final operating location. Assemblies may be inspected, tested, cleaned, protected, labeled, and documented before shipment. The site team then sets, connects, verifies, and commissions them.

Field Fabrication

Field fabrication means cutting, fitting, welding, and finishing assemblies at or near their final installed position. It provides direct access to actual conditions and permits immediate adjustments, but places more work inside the operating facility and often inside the outage window.

The Hybrid Approach

A hybrid plan divides the system at logical break points. Major manifolds and repeatable spools are fabricated in the shop, while final tie-ins, equipment connections, closure welds, and uncertain interfaces remain for the field. This approach often captures shop productivity without assuming that every existing condition is perfectly known.

Side-by-Side Comparison

Factor	Prefabrication	Field Fabrication
Installed cost	Can reduce field labor, supervision, rework, and disruption; adds detailing, packaging, and freight.	May simplify small scopes and avoids module freight; exposes more labor to site conditions and production constraints.
Schedule	Can proceed while site preparation continues and concentrates final installation into a shorter window.	Follows site access and permit constraints; fabrication occupies more of the installation window.
Quality control	Controlled lighting, tooling, purge setup, cleanliness, inspection access, and documentation support repeatable work.	Direct access to tie-ins lowers translation risk, but congestion and conditions may complicate execution.
Shipping	Requires engineered dimensions, weight, lift points, protection, route planning, and receiving.	Minimal module-shipping risk; materials, tools, gases, and consumables still require logistics.
Field-fit risk	Higher when existing conditions are poorly documented; reduced through verified dimensions, datums, and trim allowances.	Lower reliance on remote dimensions; higher exposure to access, congestion, and sequencing limits.
Shutdown duration	Usually shorter when assemblies arrive tested, labeled, and installation-ready.	Often includes more cutting, fitting, welding, inspection, and cleaning during the outage.

The correct comparison is total installed cost and total operational impact-not fabrication price alone. Shop fabrication may require greater early engineering and dimensional coordination, but those investments can avoid field hours, rework, congestion, and production disruption later.

Cost: Compare the Full Installed Picture

A credible cost comparison includes engineering, procurement, fabrication, inspection, shipping, rigging, installation, rework, commissioning, and production impact. Hourly labor rates alone are an incomplete metric.

Where Prefabrication Can Create Value

- Higher labor productivity from stable workstations, repeatable setups, material staging, and reduced travel within the plant.
- Less field supervision, permit coordination, temporary containment, lift repositioning, and cleanup.
- Earlier discovery of fabrication or documentation issues, when corrections are less likely to affect production.
- Reduced outage labor and potential avoidance of lost production.

Where Prefabrication Adds Cost

- Detailed design, dimensional verification, spool drawings, module engineering, and interface management.
- Packaging, protective closures, freight, permits, escorts, lifting frames, and site receiving.
- Potential rework if field dimensions, equipment locations, or connection details change.

A Useful Cost Model

Evaluate each strategy as: engineering and coordination + fabrication + quality activities + logistics + field installation + commissioning + expected rework + operational disruption. Use ranges for uncertain conditions. Show the financial consequence of an outage extension as an owner-defined input rather than hiding it inside construction cost.

Schedule: Move Work Off the Critical Path

Prefabrication can compress the on-site schedule because shop work may proceed in parallel with foundations, equipment procurement, utility preparation, and production planning. Its advantage is greatest when drawings, equipment data, and dimensions are released early enough to support fabrication.

Field fabrication is flexible but usually more sequential. Access must be available before measurement and fit-up; inspections follow welding; cleaning and turnover follow completion. In an operating plant, shift restrictions, line clearance, sanitation releases, and permit windows can fragment productive time.

Prefabrication does not eliminate work. It changes its location and moves more of it ahead of the outage. The schedule benefit depends on timely design decisions and disciplined interface control.

Quality Control: Control the Process

A shop environment can improve repeatability through fixed tooling, consistent lighting, controlled material storage, reliable purge setups, ergonomic positioning, and convenient inspector access. It can also simplify weld mapping, material traceability, inspection hold points, and assembly labeling.

Field fabrication can also meet demanding sanitary requirements when performed by qualified personnel under an appropriate quality plan. Site humidity, traffic, limited access, changing work fronts, airborne debris, and awkward weld positions must be actively controlled. Quality requirements should remain the same regardless of location; execution controls will differ.

Project specifications should define applicable standards, materials, surface finish, weld acceptance, inspection, testing, passivation or cleaning, documentation, and protection of open ends. ASME BPE addresses materials, design, fabrication, inspection, testing, and certification for high-hygiene applications. Project teams should apply only the standards and editions required for their process and contract.

Shipping Constraints: Design for the Journey

A module is not complete when it leaves the shop; it is complete when it reaches its final position without damage or distortion. Transportation and rigging constraints must shape the fabrication plan.

- Confirm maximum dimensions, weight, center of gravity, lifting points, trailer type, route restrictions, permits, and weather protection.
- Verify the entire site path: gate, dock, doorway, corridor, floor loading, overhead clearance, turning radius, lift access, and final orientation.
- Protect sanitary surfaces, instruments, valve operators, tubing ends, and gasket faces. Define how closures will be inspected and removed.
- Plan temporary bracing so transportation loads do not become piping misalignment or equipment-nozzle loads.

If a large module cannot travel safely or be set cleanly, break it into transportable subassemblies with intentional field joints. Choose module boundaries for access, weldability, inspection, drainability, and startup—not merely to fit a truck.

Field-Fit Risk: Match Ambition to Certainty

Field-fit risk is the central tradeoff in brownfield prefabrication. Drawings may not reflect later modifications, floors and walls may be out of square, equipment nozzles may differ from submittals, and operating loads may move supports or piping. A precise module based on inaccurate inputs is still wrong.

Controls That Reduce Field-Fit Risk

- Use laser scanning or disciplined field measurement tied to agreed control points and datums.
- Verify vendor drawings against released-for-fabrication information and flag dimensions that remain provisional.
- Maintain one source of truth for coordinates, spool revisions, nozzle orientation, elevations, and connection standards.
- Use planned closure spools, trim allowances, adjustable supports, and accessible field welds at uncertain interfaces.
- Conduct a constructability review with installers, operators, sanitation, maintenance, safety, and rigging personnel.
- Define what the fabricator controls, what equipment suppliers control, and what the field must absorb.

Shutdown Duration: Measure Readiness

The best outage plan converts shutdown work into connection work. Before production stops, assemblies should be as complete as practical; tools and consumables should be staged; permits and sanitation boundaries should be agreed; inspections should be scheduled; and contingency materials should be available.

Prefabrication can shorten the outage by relocating cutting, fitting, most welding, inspection, and documentation to the shop. It cannot compensate for incomplete isolation planning, unavailable equipment, unresolved controls, missing utilities, or an unverified installation path. Shutdown performance depends on the complete readiness system.

A Practical Decision Framework

Score each candidate assembly from 1, strongly favoring field fabrication, to 5, strongly favoring prefabrication. Weight each criterion to reflect the owner's priorities. A high score supports prefabrication; a middle score suggests a hybrid boundary; a low score supports field fabrication.

Criterion	Question to Answer	Weight
Dimensional certainty	Are tie-ins, datums, elevations, and equipment connections verified?	High
Repeatability	Are there multiple similar spools, manifolds, or skids?	Medium
Quality environment	Will shop positioning, cleanliness, access, or inspection materially improve execution?	High
Shutdown pressure	Is lost production or outage extension especially costly?	High
Transportability	Can the assembly be shipped, received, and set safely?	High
Site access	Will congestion, permits, zoning, or overhead work restrict field productivity?	Med.–High
Change likelihood	Are equipment selections, routing, or controls still evolving?	High
Interface complexity	How many uncertain owner, vendor, and contractor boundaries exist?	High

Favor Prefabrication When

- Design is stable, dimensions are verified, modules are transportable, and the shutdown carries a high operational penalty.
- Work is repetitive or benefits significantly from controlled positioning, inspection, and documentation.

Favor Field Fabrication When

- Tie-ins are uncertain, routing depends on concealed conditions, or changes are likely through installation.
- The scope is small, shipping is impractical, or direct site fit-up outweighs the shop-productivity advantage.

Favor a Hybrid Strategy When

- Most of the assembly is well defined but several interfaces remain uncertain. Prefabricate to controlled break points and finish with planned closure spools or field welds.

Common Failure Modes

- Choosing prefabrication after design is substantially complete, leaving no intentional module boundaries or field-adjustment strategy.
- Using outdated drawings or unverified vendor dimensions as fabrication control information.
- Optimizing shop labor while ignoring freight, rigging, receiving, installation path, or temporary bracing.
- Creating field joints in locations that are inaccessible, difficult to inspect, or inconsistent with hygienic and drainability requirements.

- Treating the shutdown as only a piping problem while electrical, controls, sanitation, utilities, and commissioning remain uncoordinated.
- Comparing bid prices instead of expected total installed cost and operational exposure.

Conclusion

Prefabrication is most powerful when it converts a constrained, uncertain shutdown into a controlled installation. Field fabrication is most powerful when actual conditions must guide the work. Neither method is inherently superior; performance comes from matching the fabrication location to the certainty, geometry, logistics, quality requirements, and operating consequences of each assembly.

For many sanitary process projects, the best answer is a planned hybrid: perform repeatable and well-defined work in the shop, preserve flexibility at uncertain interfaces, and arrive at the outage with tested assemblies, complete documentation, and a connection-focused installation plan.

Integrating process engineering, shop fabrication, field installation, equipment setting, and project management allows fabrication decisions to be evaluated against the complete project-not as isolated shop or field activities.

About Kodiak Process

Kodiak Process specializes in sanitary process design, fabrication, and installation for food and beverage facilities-building systems that prioritize cleanability, uptime, and long-term reliability. Contact us at info@kodiakprocess.com or visit us at www.kodiakprocess.com.